CURATORIAL NEWSLETTER	Date: January 5, 1978	No. 18
	Patrick Butler, Jr.	
	Patrick Butler, Jr., Lunar Sample Curator	

ATTACHMENTS

I. Members of the Lunar Sample Analysis Planning Team
II. List of Lunar Sample Catalogs
III. Dissection Report - 15010
IV. Report on Drill Stem 70005

CURATOR

In November Dr. Patrick Butler, Jr., became Chief of the Curatorial Branch and will be known henceforth as the Lunar Sample Curator.

SAMPLE REQUESTS

The next LSAPT meeting will be February 2-5, 1978. Please try to get your sample requests to us before January 26. The following meeting is tentatively scheduled for March 17-18.

MAILING LIST

On request we will gladly add co-investigators, collaborators and other participants in lunar sample studies to our mailing list for the Newsletters, catalogs and sample information publications. Please survey those involved in your program and let us know who would like to get their own copies of these communications.

LUNAR SAMPLE CATALOGS

Attachment II is a list of catalogs so that any that may be of use can be ordered. We will reprint those that have run out, or are about to, if requests for them are received. It may take two months, though, if the stock does run out. (We plan revisions of some of the catalogs and consequently do not want to stock up on them.)

LUNAR SAMPLE ANALYSIS PLANNING TEAM (LSAPT)

LSAPT met November 17 through November 21, 1977. Two new members, Carlton Moore, Professor of Chemistry at Arizona State University and Curator of the Nininger Meteorite Collection and David McKay of the Geology Branch at JSC overlapped with retiring members Dieter Heymann, Chuck Simonds, and Everett Gibson. (A list of the current LSAPT members is Attachment I.) The team considered the requests of 16 Principal Investigators and recommended allocation of 263 samples. The most numerous allocations are small aliquots distributed over the lengths of cores just dissected: Core 15010 samples to W. Gose for magnetic measurements; deep drill cores 70001 through 70007 to D. Lal for track studies to apply to regolith dynamics and ancient meteorite flux.

LSAPT was given a briefing on the plans to process Antarctic meteorites using techniques and equipment developed for lunar samples. (See the October 1977 Curatorial Newsletter.) Don Bogard of the Geochemistry Branch at JSC is heading up the effort. He described the freeze-drying methods that might be used and how the processing would be done in nitrogen atmosphere cabinets. Of considerable interest was the report on a meeting at the National Science Foundation in Washington which included representatives of the U.S. National Museum as well as Bogard and LSAPT member Ursula Marvin, and was chaired by Mort Turner, Program Director, Geological Studies, NSF Antarctica. LSAPT commented extensively on the protocols for the initial processing and the preliminary examination. LSAPT will continue as needed to advise on the handling of meteorites found in Antarctica but recommended constitution of a Meteorite Analysis Planning Team, with the participation of National Museums and the National Science Foundation.

HONORS

In a ceremony at JSC on December 7, 1977, NASA Administrator,Dr. Robert A. Frosch presented Dr. George W. Reed the NASA Exceptional Scientific Achievement Medal for his outstanding contributions to the lunar science program. Dr. Reed has been a Principal Investigator for eight years, served on LSAPT for four years, and for the past three years has been serving on the Facilities Subcommittee of LSAPT, which has been advising on the design of the remote storage facility for lunar samples in San Antonio and on the new storage and processing building adjoining the present curatorial laboratory building at JSC.

NEW OPPORTUNITIES: ANCIENT CLASTS IN BRECCIAS

LSAPT has recommended that this subject be brought to the attention of the lunar sample PI's. A policy has been followed for the past three years in which most sample allocations have been made in response to problem-oriented requests from investigators. The progress made in determining the petrological, chemical and isotopic evolution of the ancient lunar crust, gives testament to the vigor of scientific work in this problem-oriented mode.

Samples from the early lunar crust have now been identified. An understanding of these ancient rocks is considered essential to the determination of the formation processes of the lunar crust. Such rocks have been rare among the larger fragments studied to date. It appears that this key material is present in the form of clasts in many of the highland breccias.

To identify these clasts requires a combination of curatorial and Principal Investigator participation, since the searches require systematic examination of large amounts of material. We believe that this search should be carried out in the Curatorial Facility. Such studies can be undertaken more easily than in the past due to the greater availability of processing cabinet time and personnel.

LSAPT has recommended that high priority be given to finding and analyzing such ancient clasts. In their February meeting ways of encouraging and implementing searches for such ancient clasts, and for their analysis when found, will be considered by LSAPT. Any comments on the subject in advance of the meeting, to the Curator or a LSAPT member, would be most welcome.

CORE CATALOGS

All the available information on lunar cores is contained in two documents: Lunar Core Catalog, revised, March 1976; Lunar Core Catalog, Supplement, March 1977 with data on 60009, 60010, 70004, 70007, and 74001 (preliminary.) We have about 30 of each in stock for distribution on request. The final report on 74001 and 74002 is expected to be distributed to all PI's before February 1, 1978.

The first of four dissection passes from drive tube sample 15010 has been completed and a report is attached. A preliminary report on drill stem 70005 also is attached. The final report will include the entire drill core, 70001-70009, and will be prepared after dissection (this month) of the last stem, 70003.

Preparations are underway to saw the epoxy-impregnated portion of 74001 in half longitudinally to be followed by cross-cutting one half into 13 or so segments. Then thin sections will be made from these segments to give continuous coverage down the core length. Since there is a possibility that there may be lenses in the core not reached by the epoxy, owing to the usually dense character of the sample, the sawing will be done slowly and without cooling liquid so that further impregnation can be done if any lenses of loose soil are encountered.

Dissection of the two Apollo 11 drive tube cores has been completed. Because the stratigraphy was somewhat disturbed during colletion and suffered further disturbance from handling between the time of the early (1969) dissection of half of each core for allocation and the final dissection of the remaining halves in 1977, no part of the cores was preserved by impregnation with epoxy. Despite the disturbances, however, the strata do not seem to be greatly mixed. A final report will be distributed before mid-February.

ANNUAL REVIEW OF CONSORTIUMS

The annual reports requested from consortium leaders were reveiwed by LSAPT at the November meeting. The review identified four categories of consortium work:

- Category I - Active consortiums - sample study continuing - report submitted.
- Category II - Active consortiums - studies to be continued - no report submitted but their present proposals indicate that work will continue on samples designated as consortium samples.
- Category III - Consortium efforts which have been or are presently being terminated - report submitted.
- Category IV - No report submitted. Status unknown.

Table of consortium samples:

CONSORTIUM SAMPLES

SAMPLE NO.	LEADER(S)	SAMPLE LOCATION	CATEGORY
12013	Albee/Wasserburg	C.I.T.	II
12023	Pillinger (European Consortium)	Pillinger	I
12054	Hartung	Hartung & JSC	I
14006	Nyquist	Nyquist	II
14064	Wood	Imbrium Consortium-JSC	II
14068	Nyquist	Nyquist	II
14073	Wasserburg	C.I.T.	IV
14082	Wood	Imbrium Consortium-JSC	II
14083	Wasserburg	C.I.T.	IV
14171	Nava	Nava	IV
14276	Wasserburg	C.I.T.	IV
14305	Nava	Nava	IV
14311	Albee	C.I.T.	II
14312	Wood	Imbrium Consortium-JSC	II
14318	Wood	Imbrium Consortium-JSC	II
14319	Nava	Nava	IV
15205	Albee	C.I.T.	II
15206	Wasserburg	C.I.T.	IV
15255	Nava	Nava	III
15405	Wood	Imbrium Consortium-JSC	II
15435	Pillinger	Pillinger	IV
15445	Nyquist	Nyquist-JSC	II
15445	Wood	Imbrium Consortium-JSC	II
15455	Wood	Imbrium Consortium-JSC	II
15465	Haskin	Haskin	IV
15565	Haskin	Haskin	IV
15601	Pillinger	Pillinger	I
60002	Heymann	Heymann	II
60003	Heymann	Heymann	II
60018	Haskin	Haskin	IV
61175	Nava	Nava	III
61195	Nyquist	Nyquist	II
66075	Albee	Albee	II
67435	Keil	Keil	I
67455	Chao	Chao	III
67475	Chao	Chao	III
72417	Wasserburg	C.I.T.	II
72435	Wasserburg	C.I.T.	II
73215	James	James-JSC	I
73255	James	James-JSC	I
75081	Meinschein "Big Pot"	JSC-Berne-Chicago	III
76015	Phinney	JSC	III
76215	Phinney	JSC	III
76235	Phinney	JSC	III
76255	Phinney	JSC	III

CONSORTIUM SAMPLES (Contd)

SAMPLE NO.	LEADER(S)	SAMPLE LOCATION	CATEGORY
76275	Phinney	JSC	III
76295	Phinney	JSC	III
76315	Phinney	JSC	III
77075	Chao	Chao-JSC	III
77115	Chao	Chao-JSC	III
77135	Chao	Chao-JSC	III

Material from samples with active consortiums may be requested by non-consortium PI's, but the proposed study will be checked to see that it does not infringe on a similar study within the consortium. In addition, the selection of sample has to be cleared with the consortium leader to assure that material essential to the consortium study (because of location or lithology, for example) would not be involved in the allocation. Communication with the consortium leader prior to submitting the request speeds and simplifies the checking and usually results in a recommendation of appropriate samples by the leader.

CONTAMINATION WARNING

We have recently had reports of contamination of lunar samples by containers of two types:

1. Teflon shavings in FTH containers (3/4 inch diameter stainless steel tubes with white Teflon snap-off caps). A rough or sharp lip on the stainless steel tubes cuts into and shaves off slivers from the caps on some of these containers. We are now rounding off and smoothing the lips of all of these containers before cleaning them for use.

2. Stainless steel particles in WAP containers (1/2 inch long screws with hexagonal socket (Allen) heads. The sample goes into the recessed socket and is held there by a Teflon cap.) The bottoms of the sockets on the first batch of these containers were roughly finished. The present type is smoothly finished. We are discarding the few remaining of the older type.

We apologize for difficulties caused by problems of this sort. Let me know promptly when they occur so we can act to correct them.

November 21, 1977

LSAPT MEMBERSHIP

Dr. Robert M. Housley
Rockwell International, Science Ctr.
1049 Camino Dos Rios
Thousand Oaks, California 91360
(805-498-4545)(FTS: 87-798-2000)

Mr. Richard S. Johnston, Chairman
NASA Johnson Space Center
Space & Life Sciences Directorate, SA
Houston, Texas 77058
(713-483-2251)(FTS: 87-525-2251)

Dr. Klaus Keil (Vice-Chairman)
University of New Mexico
Department of Geology
Institute of Meteoritics
Albuquerque, New Mexico 87131
(505-277-2747)(FTS: 87-474-5511)

Dr. Michael E. Lipschutz
Purdue University
Department of Chemistry
Lafayette, Indiana 47907
(317-749-2724)(FTS: 87-331-7000)

Dr. Kurt Marti
University of California, San Diego
Department of Chemistry
P.O. Box 109
La Jolla, California 92037
(714-452-2939)(FTS: 87-895-5000)

Dr. Ursula B. Marvin
Smithsonian Institution
Astrophysical Observatory
60 Garden Street
Cambridge, Massachusetts 02138
(617-495-7270)(FTS: 87-830-7270)

Dr. David S. McKay
NASA Johnson Space Center
Geology Branch, SN6
Houston, Texas 77058
(713-483-5171)(FTS: 87-525-5171)

Dr. Carleton B. Moore
Center for Meteorite Studies
Arizona State University
Tempe, Arizona 85281
(602-965-3576)(FTS: 87-766-3576)

Dr. Hartmut Spetzler
University of Colorado
CIRES
Boulder, Colorado 80309
(303-492-8020)(FTS: 87-323-6516 x-8020)

Dr. Lawrence A. Taylor
University of Tennessee
Department of Geology
Knoxville, Tennessee 37916
(615-974-2366)(FTS: 87-855-2366)

Dr. W. Randy Van Schmus
University of Kansas
Department of Geology
Lawrence, Kansas 66004
(913-864-3676)(FTS: 87-752-8661)

November 21, 1977

LSAPT SUBGROUPS

Group A	Group B	Group C
Marvin (Chr)	Lipschutz (Chr)	Housley (Chr)
Keil	Van Schmus	Spetzler
McKay	Moore	
Taylor	Marti	

LSAPT SUBCOMMITTEES

Cleaning	Consortia	Cores
Lipschutz (Chr)	Van Schmus (Chr)	McKay (Chr)
Marti	Marvin	Lipschutz
Van Schmus	Moore	Housley
		Taylor

Cutting	Data	Facilities
Taylor (Chr)	Marti (Chr)	Bell (Chr)
McKay	Spetzler	Nyquist
Spetzler		Papanastassiou
		Pepin
		Reed
		Wasserburg
		Bence

Public Displays	SSPL & RSPL	Procedures Annex
Spetzler (Chr)	Marvin (Chr)	Taylor (Chr)
Housley	Lipschutz	Lipschutz
Taylor	Van Schmus	Marti
Marvin	Marti	Housley
Moore		McKay

LUNAR SAMPLE CATALOGS

January 4, 1978

	Date of Publication	Number of copies
Apollo 11		
A Summary of Apollo 11 Chemical, Age and Modal Data	1971	103
Lunar Sample Information Catalogue (Revised) JSC 12522	2-1977	32
Apollo 12		
NASA Technical Report S-243 Apollo 12 Lunar-Sample Information	6-1970	
Apollo 14		
Description, Classification, and Inventory of the Comprehensive Sample from Apollo 14	1975	69
NASA TM X-58062 NASA TECHNICAL MEMORANDUM Apollo 14 Lunar Sample Information Catalog	9-1971	47
Apollo 14 Coarse Fines (4-10mm) Sample Location and Classification	6-1977	7
Apollo 15		
Apollo 15 Coarse Fines (4-10mm): Sample Classification, Description, and Inventory	1972	48
Lunar Sample Information Catalog Apollo 15 Lunar Receiving Laboratory	11-1971	20
Apollo 16		
Description, Classification, and Inventory of Apollo 16 Rake Samples from Stations 1, 4, 13	1973	120
Description, Classification, and Inventory of 151 Apollo 16 Rake Samples from the LM Area and Station 5	1972	90
Lunar Sample Information Catalog Apollo 16 Lunar Receiving Laboratory	7-1972	23
Apollo 16 Coarse Fines (4-10mm): Sample Classification, Description and Inventory	10-1972	70

	Date of Publication	Number of copies
<u>Apollo 17</u>		
Description, Classification and Inventory of 113 Apollo 17 Rake Samples from Station 1A, 2, 7, and 8	1974	20
Apollo 17 Coarse-Fines (4-10mm): Sample Location Classification and Photo Index	1973	110
Lunar Sample Information Catalog Apollo 17 Lunar Receiving Laboratory	4-1973	9
Description, Classification, and Inventory of Apollo 17 Rake Samples from Station 6	9-1974	241
<u>Luna 24</u>		
Luna 24 Samples Presented to the USA, 1977 Catalog and Preliminary Description	5-1-1977	30

COPIES NO LONGER AVAILABLE

Apollo 16 Special Samples	COPIES NO LONGER AVAILABLE
The Apollo 16 Lunar Samples: A Petrographic and Chemical Description of Samples from the Lunar Highlands	COPIES NO LONGER AVAILABLE
Apollo 16 Rake Samples 67515 to 68537 Sample Classification, Description, and Inventory	COPIES NO LONGER AVAILABLE

DISSECTION REPORT - 15010

By Judith Allton
Northrop Services, Inc.

First Dissection of 15010 - An Interim Report on Soil Unit Identification

The first dissection of core 15010 was completed 10-28-77. This core was the lower half of a double drive tube sample taken on the rim of Hadley Rille.

Figure 1 compares 1), units observed in 1977 x-rays, 2), units defined by soil color as seen on flat surface after 1st dissection, and 3), units defined by distribution of coarse fragments (>1 mm) in the dissected intervals (.5 cm increments). The units defined by composition will be the numbered units by which the core will be known.

Units Defined by X-ray:

Six units were identified from the 1977 x-radiograph. Larger fragments and fines and varying density were distinguishable; therefore, units were characterized by coarseness and density. These six units are shown in Fig. 1. In correlating x-ray units to observed surface units it is necessary to know how much compaction occurred. When the core was x-rayed in 1977, the follower was 32.9 cm. from the bottom of the tube. The core had lain horizontally in storage. Settling of material during this time left void spaces at the ends of the core on the side facing up. In preparation for extrusion, the core was placed vertically with the bottom end up. Approximately 1 cm. of material was removed from the bottom of the core, and the resulting core length was 30.9 cm. Therefore, about 1 cm of compaction must have occurred at this time. During extrusion the core was shortened by 2 cm. resulting in the present 28.9 cm. length.

Units Defined by Soil Color:

Six units were identified by the soil color observed on the flat surface after layer "A" was removed. (In the dissection procedure, the quartz top was removed, 1-2 mm of rind were removed, then layer "A" was removed leaving a flat surface flush with the aluminum surface.) Soil color was observed to range from 5Y 2/1 to 5Y 4/1 on the Munsell Color Scale in fluorescent room light. Distinctions between color units were vague. Value observations were made in white, yellow, red, green and light blue. Yellow light most enhanced the contrast.

Units Defined by Distribution of Fragments >1 mm:

The core was dissected in .5 cm increments. Each increment was sieved thru a 1 mm screen. The particles greater than 1 mm were categorized in the following seven lithologies: basalts, soil breccia, glass, agglutinates, anorthositic breccia, devitrified glass or recrystallized breccia. Particle weights were taken in each category. Unit definition was based on the lithology distribution by weight and on the distribution of percent of coarse material. The changes in coarseness or amount of basalt, for example, were determined from graphs made of (1) percent material >1 mm vs. depth in core and (2) abundance of rock type by weight vs. depth in core.

The units defined by this data should be viewed with caution since no corrections were made for particles included in layer "A" which extended down into layer "B" which was not dissected. Nor were corrections made for particles left in layer "B" but which protruded up into layer "A". This type of distortion was especially great in the bottom of the core where a 4 cm.-long piece of basalt was partially excavated when layer "A" was removed.

Unit I 27.0 - 28.9 cm

17% material >1 mm

Basalt/Soil Breccia/Glass = 1/.8/.5

Glass was more abundant in this coarse unit. Amounts of basalt and soil breccia were more nearly equal than in other units. Trends in lithology distribution within the unit were not observed.

Unit II 20.5 - 27.0 cm

17% material >1 mm - This does not include large rock.

Basalt/Soil Breccia/Glass = 1/.3/.05

Basalt dominates this very coarse unit. A large piece of basalt was located at 22.5 - 26.8 cm. Since this basalt fragment was not entirely included in the dissected portion of core, it remained with the undissected part. Therefore, fractional shares of this rock were not included in the calculations for coarseness or lithologic content, and these numbers do not correctly represent this unit. A very small amount of glass was noted, and soil breccia distribution was sporadic in range and location.

Unit III 17.0 - 20.5 cm

12% material >1 mm

Basalt/Soil Breccia/Glass = 1/.3/.3

Basalt was most abundant in this coarse unit. The amounts of soil breccia and glass were nearly equal and were evenly distributed.

Unit IV 12.5 - 17.0 cm

12% material > 1 mm

Basalt/Soil Breccia/Glass = 1/.1/.1

This coarse unit was dominated by basalt. The very small amounts of soil breccia and glass were nearly equal and were evenly distributed.

Unit V 11.0 - 12.5 cm

29% material >1 mm

Basalt/Soil Breccia/Glass = 1/.1/.04

Basalt dominated this very coarse unit. Soil breccia and glass were found in equal portions and in small quantity. The lithologic distribution within the unit showed no trends, except for a large increase in basalt in the bottom one-half centimeter.

Unit VI 9.0 - 11.0 cm

22% material >1 mm

Basalt/Soil Breccia/Glass = 1/1.1/.4

In this very coarse unit soil breccia was most abundant. Substantial amounts of basalt were evenly distributed throughout the unit. There was an increase in glass and soil breccia content toward the top of the unit. Most unusual was the occurrence of a large (1 centimeter diameter) "agglutinate" at the very top of the unit. This "agglutinate" consisted of soil clods glued together in angular fashion with black splash glass. (For purposes of lithology distribution this particular piece was apportioned 50% to soil breccia and 50% to glass.)

Unit VII 3.0 - 9.0

7% material >1 mm

Basalt/Soil Breccia/Glass = 1/.2/.1

Basalt was dominant and evenly distributed in this relatively fine unit. Soil breccia appeared to increase with depth. Glass was of low abundance and of even distribution.

Unit VIII 0.0 - 3.0

10% material >1 mm

Basalt/Soil Breccia/Glass = 1/1.6/.7

In this coarse unit, soil breccia content, which was most abundant, decreased with depth. The second abundant most component, basalt, increased with depth. Glass content was concentrated in the top centimeter which also appeared slightly darker in color.

15010: First Dissection Units

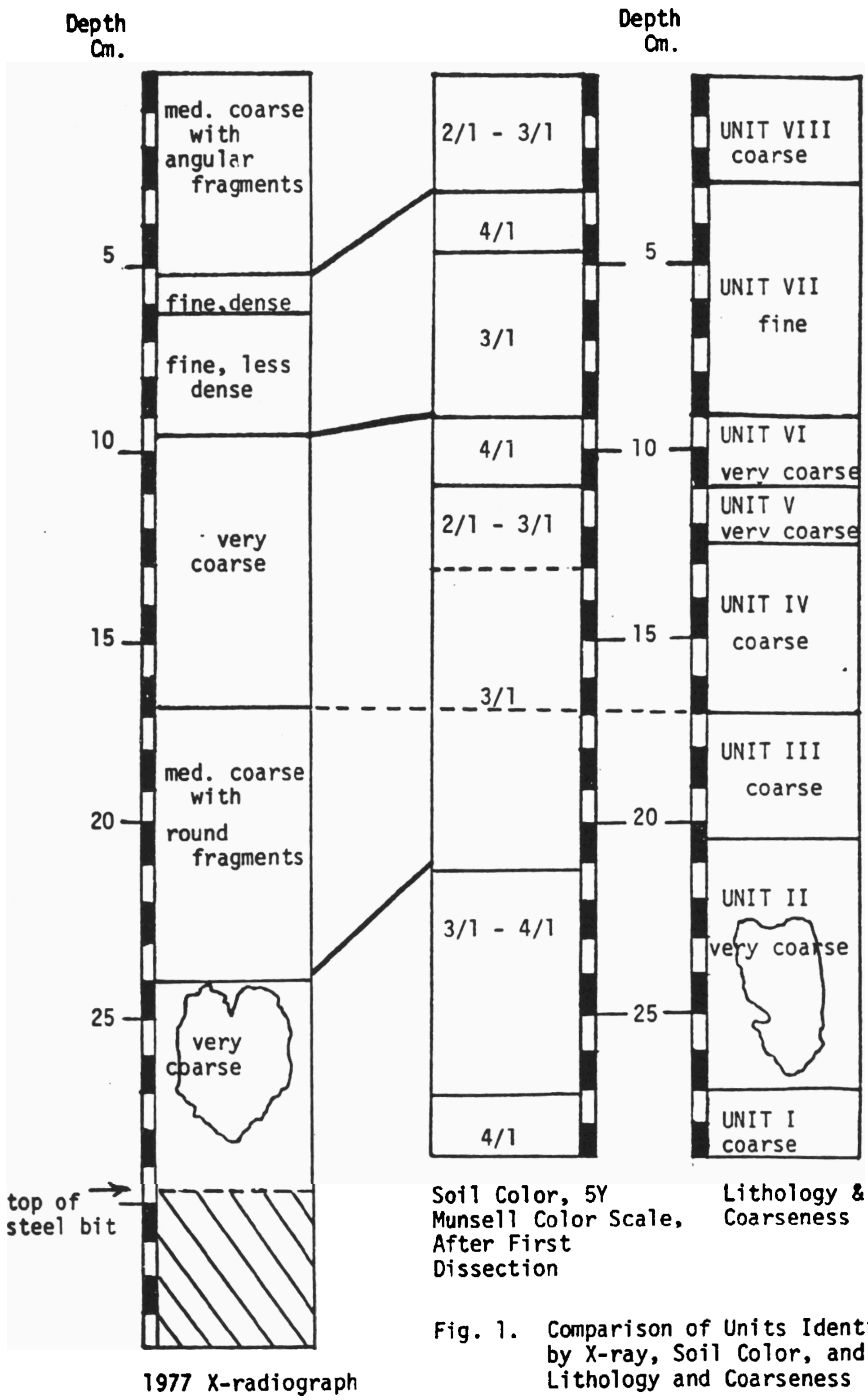


Fig. 1. Comparison of Units Identified by X-ray, Soil Color, and Lithology and Coarseness

TABLE 1 - DRIVE TUBE 15010: LOCATION OF SAMPLES FROM FIRST DISSECTION

		INTERVAL SAMPLES				SPECIAL SAMPLES			
		Fine Fraction		Coarse Fraction					
	Interval Cm.	Sample Number	Weight Grams	Sample Number	Weight Grams	Interval Cm.	Sample Number	Weight Grams	Description
	.5 - 0	12	.130	13	.010				
	1.0 - .5	14	.477	15	.086				
	1.5 - 1.0	16	.677	17	.073				
Unit VIII	2.0 - 1.5	18	.681	19	.061				
	2.5 - 2.0	20	.723	21	.070				
	3.0 - 2.5	22	.813	23	.026	3.1 - 2.8	24	.105	Soil breccia
	3.5 - 3.0	25	.682	26	.040				
	4.0 - 3.5	27	.974	28	.043				
	4.5 - 4.0	29	.920	30	.071				
	5.0 - 4.5	31	.804	32	.022	5.3 - 4.8	33	.148	Basalt
	5.5 - 5.0	34	.864	35	.052				
Unit VII	6.0 - 5.5	36	.935	37	.064				
	6.5 - 6.0	38	1.129	39	.086				
	7.0 - 6.5	40	1.017	41	.050				
	7.5 - 7.0	42	1.025	43	.123				
	8.0 - 7.5	44	1.146	45	.070				
	8.5 - 8.0	46	1.080	47	.090				
	9.0 - 8.5	48	1.154	49	.047				
	9.5 - 9.0	50	.848	51	.173	10.0 - 9.0	54	.250	Soil breccia + glass
Unit VI	10.0 - 9.5	52	1.012	53	.078				
	10.5 -10.0	56	.889	57	.496	11.1 -10.0	55	.047	Light gray soil
	11.0 -10.5	58	.696	59	.075				
	11.5 -11.0	60	.995	61	.309				
Unit V	12.0 -11.5	62	.949	63	.174				
	12.5 -12.0	64	.801	65	.721				
	13.0 -12.5	66	1.010	67	.054				
	13.5 -13.0	68	1.102	69	.094				
	14.0 -13.5	70	.933	71	.100				
	14.5 -14.0	72	1.054	73	.053				
Unit IV	15.0 -14.5	75	.976	76	.098	15.0-14.0	74	.258	Basalt
	15.5 -15.0	77	1.117	78	.060				
	16.0 -15.5	79	1.085	80	.358				
	16.5 -16.0	81	.968	82	.137				
	17.0 -16.5	83	1.082	84	.082				
	17.5 -17.0	85	1.163	86	.062				
	18.0 -17.5	87	1.188	88	.120				
	18.5 -18.0	89	1.079	90	.195				
Unit III	19.0 -18.5	91	1.099	92	.226				
	19.5 -19.0	93	1.045	94	.156				
	20.0 -19.5	95	1.176	96	.199				
	20.5 -20.0	97	1.089	98	.116				
	21.0 -20.5	99	1.057	100	.314				
	21.5 -21.0	101	1.001	102	.106	21.6-20.8	103	.232	Basalt
	22.0 -21.5	104	1.094	105	.181				
	22.5 -22.0	106	1.064	107	.156				
	23.0 -22.5	108	.935	109	.061				
	23.5 -23.0	110	.805	111	.088				
Unit II	24.0 -23.5	112	.694	113	.278				
	24.5 -24.0	114	.767	115	.117				
	25.0 -24.5	116	.727	117	.158				
	25.5 -25.0	118	.850	119	.208				
	26.0 -25.5	120	.723	121	.095				
	26.5 -26.0	122	1.088	123	.251				
	27.0 -26.5	124	.951	125	.266	27.0-26.8	126	.015	Green anorthosite
	27.5 -27.0	127	.894	128	.188				
Unit I	28.0 -27.5	129	1.146	130	.271				
	28.5 -28.0	131	.963	132	.215				
	28.9 -28.5	133	.745	134	.103				

REPORT ON DRILL STEM 70005

Drill stem 70005 is the fifth stem below the top of the Apollo 17 Drill String. Calculations based on x-radiographs and previous dissections of other drill stems in the string place the top of 70005 at 132 cm below the lunar surface. Due to various factors such as mechanical compaction, this figure is only a close approximation. The drill string, with a total length of about 294.5 cm, has three major stratigraphic units: an upper, coarse-grained, basaltic unit, 107 cm thick; a middle, fine-grained zone 56 cm thick, high in anorthosite; and a lower zone of alternating coarse and fine basaltic and breccia meterial, 131.5 cm thick. Part of each of the lower major units is contained in drill stem 70005. The Apollo 17 Deep Drill String was taken about 40 meters north of the ALSEP central station.

Sample History

Upon extraction of the drill string from the drill hole, the string was separated into three segments for packing. Drill stem 70005 was the bottom stem of the middle, two-stem segment -- 70006 being the top stem. An internal-fitting, hollow cap was installed at the lower end of 70005 at this time. The hollow nature of the cap allowed soil to shift from 70006 into 70005, thus filling the cap with soil indirectly. Drill stem 70006 was short by 1.2 cm of soil column and 70005 was long by about 1.8 cm. The 0.6 cm difference is probably due to low density zones such as seen in the attached x-radiograph diagram.

Burrowed end samples were taken at the upper end totaling nearly 6 grams or the equivalent of 11 mm of soil column. Prior to milling, another 6.6 grams or the equivalent of 12 mm of soil column was removed from the lower end in order to properly contain the soil during the milling operation.

The remaining soil was compressed by 1.5 cm as a pre-milling stablization measure. The resultant soil column was 38 cm in length. The upper soil/plug interface became established at 2.0 cm and the lower interface at the 40.0 cm mark.

Pre-Dissection Description

The exposed surface of the core closely correlates with the x-ray interpretation. The boundary between the lower and middle major units of the drill string is evidenced by a broken rind below about 29 cm and by the coarseness below 30 cm as seen in the x-radiographs and exposed surface. In addition, the soil tone below 30 cm is noticeably lighter. Further subdivisions into units cannot be inferred from the exposed surface. The overall color is closest to 10Y 3/1 on Munsell's Color Chart. The matrix soil grain size is in the silt range.

Processing Procedures

Dissection began at the lower end of the core in order to more quickly process the intervals with disrupted rind. Standard 5mm intervals were taken throughout, with the exception of lead-free sample intervals at 23.0-24.5 cm and 6.5-8.0 cm. Red light samples were taken in conjunction with the lead-free samples and additionally at 15.0-15.5 cm and 30.0-30.5 cm. Also, the interval 31.0-32.0 was taken double due to a large particle which filled most of the interval. Unusual or large particles transcending interval boundaries were individually containerized as special samples. Whereever possible, large particles were located on a diagram of the interval in order to record orientations. All particles not passing through a 1mm sieve were classified, photographed, and containerized for each dissection interval. Voids created by the extraction of large particles extending below standard dissection depth were maintained if possible. It was necessary to remove these particles in order to obtain a peel sample. At 30 cm, a void created by the removal of a large particle caused a gap in the peel record of 5mm. After peeling, the remaining core was impregnated with epoxy, then encapsulated in a mold of epoxy. This mold provides a block of epoxy containing sample which is longitudinally split and transversely cut into blocks for thin-sectioning.

ANALYSIS OF DATA

The collected quantitative data consists of the weights of the fine fraction and coarse fraction of each interval, plus the weights of special samples. In addition, frequency counts of particles in the coarse fraction were taken in three size ranges — 1-2 mm, 2-4 mm, and greater than 4 mm. Each size range is also divided into seven compositional types. Frequencies are computer-normalized to the standard interval width and average weight. Graphs of normalized frequencies versus depth are plotted in eight groupings: by compositional type for each of the three size ranges; by compositional type for the combined sizes; by combined compositions for each of the three sizes; and by combined compositions for the combined size ranges. When combining sizes, scale factors are used. In addition to the frequency graphs, a weight percent coarseness indicator is plotted. The percentages are computed by dividing the weight of material greater than 1 mm in size by the weight of all the material per unit.

Bias is introduced by the sampling size of the drill stem, in that the presence of a particle approaching tube diameter in size eliminates the possibility of occurence of other particles. Other statistical error is brought about by the discrete size categorization, rather than a continuous size measurement of each particle. This error is demonstrated by comparing the weight percent coarseness graph with the combined composition/ combined sizes graph. The lack of congruence that can be seen is partially due to this "pidgeonhole" effect and partially due to generalizing assumptions that had to be made in order to combine the discrete size categories. Other biases or errors include — sampling below standard dissection level, measurement error, assumptions of uniform density, and mis-classification of lithology. Bearing these limitations in mind, interpretation of the constructed graphs was not attempted at the order of resolution provided.

COMPOSITIONAL DESCRIPTIONS

Seven compositional categories were used to classify particles greater than 1 mm in grain size: anorthositic breccia (ANBX); agglutinates (AGGL); devitrified or partially-crystallized glasses (PXGL); recrystallized or high-grade breccia (RXBX); vesicular, droplet, or fresh glasses (VSGL); soil or low-grade breccia (SOBX); and basaltic or crystalline rock fragments (BSRF). Of these seven, SOBX is by far the most abundant.

The category "BSRF" includes any particle which is apparently no recrystallized material, but is polycrystalline and contains plagioclase and pyroxene. In practice, some of the smaller particles classified as BSRF's may be monomineralic. Also, many particles are soil or glass coated to the point of being barely recognizable. Some soil coated BSRF's may have been misclassified as SOBX's for this reason. Most occur as fairly equant chunks with coarsely-textured surfaces. When the rough pockets in the surface are filled with soil, they are easily mistaken for the equant, smooth-surfaced SOBX's. Effort was taken to remove as much loose soil as possible SOBX's without significantly damaging the normally friable SOBX's in the process. Some BSRF's have shocked plagioclase or anorthositic material. ANBX's may be derived directly from this source, in which case they are more likely to display some evidence of crystal structure. When found as clasts in SOBX's, they tend to be sugary in texture. Some particles classified as "ANBX" may either be soil coated ANBX's or anorthositic clasts from broken SOBX's. SOBX's therefore, exclude white, sugary masses of supposed anorthositic material, even though the only difference may be the color of the soil matrix in which it is formed. "SOBX" refers to a particle of welded, non-white soil matrix. Welding may have been brought about by heat, pressure, small amounts of molten glass, or some combination of these. When glass welding creates a more spindly particle, it is considered to be an "AGGL" rather than a more massive and rounded SOBX. SOBX's are usually friable and occasionally break open to reveal an interior of crystalline mash. Others simply disintegrate when broken. Certain SOBX's are distinguished as medium grade in that they are tougher and seemingly transitional to the category of RXBX. "RXBX" is an angular, waxy-appearing particle that would seem to be the high grade equivalents of SOBX or ANBX. "PXGL" is somewhat similar in appearance to RXBX, but readily distinguishable by a duller surface luster and glass fracture shape characteristics, as it is a devitrified form of VSGL. "VSGL" refers to fresh, vitreous glass which occurs as beads, shards, or coatings. It is often found as coatings on SOBX and causes some difficulty in classification, as SOBX may be glass welded.

Descriptions of Physical Units

Drill stem 70005 contains parts of two major units of the drill string. The upper unit, together with the lower part of 70006, comprise the middle major unit of the drill string, which is characterized by moderate tone and cohesivity and a fine-grained texture. Compositionally, it is glass-rich. The basal sub-unit is coarse with large chunks of vesicular glass. The contact with the lower unit is marked by a lightening of tone and increases in cohesivity, coarseness, and BSRF content.

In drill stem 70005, nine minor units are marked off -- eight above the major unit contact. The minor units are further subdivided into seventeen sub-units, mostly based on variations seen in tone, cohesivity, and coarseness. See the chart below for a detailed account of these variations.

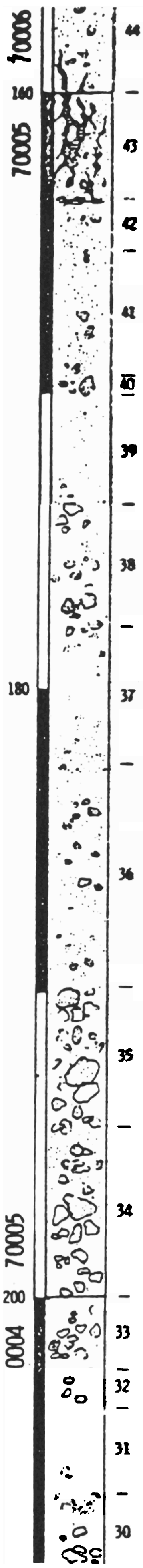
70005 Physical Unit Description Index

70005 Unit	X-Ray Unit	Depth below Lunar Surface	Unit Thickness	Internal Location Notation	Sample Numbers	Wt.% Matrix	Tonal Value	Rel.Cohesion	Major Comp.	Minor Comp.	Other features Minor Comp.
IX	43	132.6	3.1	040-09	171-178	94	6	7	-	SOBX	
VIIIB	42	135.7	1.5	055-40	165-170	91	5	6	SOBX	-	
VIIIA	41/2	137.2	1.0	065-55	161-164	91	5½	4	SOBX	-	Sl.Mottling
	41	138.2	2.0	085-65	155-160	95	5	5	-	SOBX	Mottled
VIIA	40/1	140.2	2.0	105-85	147-154	92	6	6	SOBX	VSGL	
VIB	39	142.2	1.5	120-05	141-146	97	6	2	-	-	
VIA	39	143.7	1.5	135-20	135-140	97	6	4	-	-	
VC	38	145.2	1.0	145-35	131-134	90	5½	5	-	BSRF	
VB	38	146.2	1.7	162-45	124-130	95	4½	6	SOBX	-	
VA	38	147.9	1.3	175-62	118-123	88	5	4	SOBX	-	
IV	37	149.2	4.0	215-75	102-117	96	5	5	-	VSGL	
III	36	153.2	5.3	268-15	84-101	92	5½	2	-	SOBX	
IIB	35/6	158.5	2.7	305-68	66-83	79	6	1	SOBX	PXGL	Lt.Streaks
	35	161.2	2.5	330-05	57-65	58	6	3	VSGL	SOBX	
IC	34	163.7	2.5	355-30	46-56	76	8	6	SOBX	VSGL	PXGL
IB	34	166.2	2.5	380-55	36-45	72	7	7	SOBX	VSGL	BSRF
IA	34	169.7	3.2	412-80	25-35	83	7½	8	SOBX	VSGL	BSRF
70004		172.9									

Relative Tonal Value -- 10=White/0=Black
Relative Cohesion Value -- 10=Tight/0=Loose

PHYSICAL UNIT	LUNAR DEPTH (CM)	THICKNESS (CM)		INTERVAL Location Notation	FINE FRACTION Sample Number	FINE FRACTION Weight (mg)	COARSE FRACTION Sample Number	COARSE FRACTION Weight (mg)	SPECIAL SAMPLES Location Notation	SPECIAL SAMPLES Sample Number	Weight (mg)	Compositional Description
70005	132.6	3.1		020-09	3	2925	4	35	009-00	2	40	Joint/Compact.
IX				025-20	177	2134	178	173	020-09	5	3026	Cold Storage
				030-25	175	2086	176	131				
				035-30	173	2267	174	64				
				040-35	171	2050	172	164				
70005	135.7	2.5		045-40	169	2118	170	78				
VIII				050-45	167	2100	168	268				
B				055-50	165	1972	166	258				
				060-55	163	2252	164	123				
A				065-60	161	1851	162	272				
70005	138.2	4.0							080-65	160	400	Red Light
VII				080-65	157	5255	158	370	080-65	159	1030	Lead Free
B				085-80	155	2110	156	90				
				090-85	153	1995	154	164				
				095-90	151	2338	152	77				
				100-95	149	2120	150	290				
A				105-00	147	1930	148	210				
70005	142.2	3.0		110-05	145	2319	146	38				
VI				115-10	143	2212	144	60				
B				120-15	141	2235	142	81				
				125-20	139	2118	140	52				
				130-25	137	2277	138	87				
A				135-30	135	2192	136	66				
70005	145.2	4.0		140-35	133	2257	134	267				
V C				145-40	131	2182	132	205				
				150-45	129	2040	130	48				
				155-50	126	1705	128	250	155-50	127	440	Red Light
B				160-55	124	2144	125	79				
				165-60	122	1981	123	85				
				170-65	120	2189	121	430				
A				175-70	118	2013	119	218				
70005	149.2	4.0		180-75	116	2210	117	80				
IV				185-80	114	2297	115	86				
				190-85	112	2146	113	109				
				195-90	110	2173	111	76				
				200-95	108	2093	109	73				
				205-00	106	2124	107	125				
				210-05	104	2212	105	86				
				215-10	102	2096	103	77				
70005	153.2	5.3		220-15	100	2135	101	230				
III				225-20	98	2188	99	165				
				230-25	96	2175	97	107				
									245-30	95	400	Red Light
				245-30	92	4665	93	470	245-30	94	1025	Lead Free
				250-45	90	2295	91	250				
				255-50	88	2188	89	100				
				260-55	86	2231	87	152				
				265-60	84	2163	85	128				
				270-65	82	1820	83	134				
70005	158.5	5.2		275-70	80	1693	81	104				
II				280-75	78	2190	79	248				
				285-80	76	2165	77	212				
			73	290-85	74	1710	75	170				
				295-90	71	1825	72	265	294-85	73	848	PXGL
				300-95	69	1970	70	260				
B				305-00	66	1706	67	79	305-00	68	400	Red Light
			63	310-05	64	1650	65	105				
				320-10	61	2403	62	642	319-07	63	2485	VSGL
				325-20	59	1732	60	658				
A				330-25	57	1851	58	667				
70005	163.7	8.2		335-30	55	1973	56	717				
				340-35	53	1900	54	367				
				345-40	51	1800	52	625				
				350-45	49	1750	50	562				
C				355-50	46	2188	47	440	360-51	48	580	SOBX
			48	360-55	44	1229	45	1002				
				365-60	42	1465	43	862				
				370-65	40	2097	41	582				
				375-70	38	1776	39	583				
B				380-75	36	1737	37	644				
				385-80	34	1956	35	396				
				390-85	32	1502	33	773				
			31	395-90	29	2040	30	307	396-86	31	346	SOBX
				400-95	27	2169	28	541				
A				412-00	25	6236	26	350				
				412-20	180	1006	181	10	400-20	179	637	Funnel Misc.

(See text of this report for explanation of acronyms and other descriptions.)



Moderately opaque interval with small, scattered, sorted rock fragments.
Matrix: 85 percent; moderately opaque with ≈20 percent indistinct equant mottles, near limit of resolution to 0.5 mm, 1 percent opaque spherules less than 0.5 mm in diameter.
Coarse fraction: 15 percent; semiopaque with partially distinct outline (probably partially concealed by density of matrix), 3 to 5 mm, well sorted, equant to ovoid, subrounded particles, long axes tend to be alined horizontally.

UNIT 43 Depth: TDS, 160 to 164 cm; lunar surface, 133 to 137 cm Thickness: 4 cm
Rock fragmental unit fractured at top of core.
Matrix: 70 percent; appears similar to that of unit 42, but is strongly permeated by cracks and fractures, contains ≈20 percent finely granular mottles, traces of opaque spherules, near limit of resolution.
Coarse fraction: 30 percent; clumps or rock fragments with distinct outline, 2 to 11 mm in diameter, subovoid to polygonal with irregular angularly wavy edges most commonly defined by cracks in matrix.

UNIT 42 Depth: TDS, 164 to 166 cm; lunar surface, 137 to 139 cm Thickness: 2 cm
Thin bed with moderately opaque matrix and small sorted rock fragments.
Matrix: 80 percent; intermediate opacity, finely mottled with 20 percent pinpoint mottles, less than 1 mm in diameter, but no opaques.
Coarse fraction: 20 percent; semiopaque rock fragments with moderately distinct outline, 1 to 4 mm in diameter, average 2.5 mm with few fragments being much smaller or larger, fragments with one or two relatively straight margins, but fading out along crenulate margins on other side of fragment.

UNIT 41 Depth: TDS, 166 to 170 cm; lunar surface, 139 to 143 cm Thickness: 4 cm
Fine-grained interval with scattered fine mottles and sparse rock fragments.
Matrix: 95 percent of intermediate to low opacity, with 5 to 15 percent mottles under 1 mm in diameter and ≈1 percent spherical opaques, limit of resolution to 0.8 mm.
Coarse fraction: 5 percent; semiopaque rock fragments with distinct outline, blocky slightly elongate with relatively straight edges and angular corners.

UNIT 40 Depth: TDS, 170 to 170.5 cm; lunar surface, 143 to 143.5 cm Thickness: 0.5 cm
Thin rock layer.
Matrix: 60 percent; moderately transparent and uniformly fine grained.
Framework: 40 percent; semiopaque rock fragments with distinct outline, 1 to 4 mm in diameter, moderately well sorted, equant to slightly elongate, with smoothly faceted to blocky outline, subangular to angular corners.

UNIT 39 Depth: TDS, 170.5 to 174.5 cm; lunar surface, 143.5 to 147.5 cm Thickness: 4 cm
Fine-grained interval with indistinct granules.
Matrix: 95 percent; moderately high transparency, but with 2 percent opaques, ranging from spheroids at limit of resolution to shards 1 mm long; elongate opaques tend to have long axes alined horizontally.
Coarse fraction: 5 percent; semiopaque density concentrations with indistinct outline, 1 to 3 mm in diameter with regular and even fadeout as in unit 37.

UNIT 38 Depth: TDS, 174.5 to 178.5 cm; lunar surface, 147.5 to 151.5 cm Thickness: 4 cm
Medium-thin interval with abundant, small, well-sorted rock fragments.
Matrix: 70 percent; moderate to high transparency, with less than 10 percent fine mottles and only a trace of pinpoint opaques, near limit of resolution.
Framework: 30 percent; 20 percent is semiopaque rock fragments with distinct outline, 2 to 4 mm in diameter, well sorted, blocky to wedge shaped with nearly straight sides and angular to subangular corners; 10 percent is semiopaque density concentrations with indistinct outline, 2 to 4 mm diameter, fading out over relatively straight and even edge, suggesting breccia fragments.

UNIT 37 Depth: TDS, 178.5 to 183 cm; lunar surface, 151.5 to 156 cm Thickness: 4.5 cm
Densely granular interval with sparse rock fragments.
Matrix: 95 percent; more opaque than unit 36, densely and finely granular with traces of minute spherical opaques.
Coarse fraction: 5 percent; semiopaque with indistinct outline, appearing as equant density concentrations 1 to 3 mm in diameter, with regular and even fadeout, sorting and type of semitransparency suggest breccia fragments rather than clods.

UNIT 36 Depth: TDS, 183 to 190 cm; lunar surface, 156 to 163 cm Thickness: 7 cm
Massive interval with sparse rock fragments and abundant opaque fragments.
Matrix: 90 percent; uniformly fine grained and noticeably transparent with ≈1 percent spherical opaques, 0.5 mm to limit of resolution.
Coarse fraction: 10 percent (decreasing upward); 5 percent is semiopaque rock fragments having distinct outline, moderately well sorted, 2 to 3 mm in diameter, best sorting at top of bed, continuous gradation upward; 4 percent is semiopaque mottles, 1 to 4 mm in diameter with crenulate fadeout; 1 percent is opaque fragments, averaging 1 mm in diameter, blocky equant to comma shaped.

UNIT 35 Depth: TDS, 190 to 194.5 cm; lunar surface, 163 to 167.5 cm Thickness: 4.5 cm
Rock fragmental zone with relatively transparent matrix.
Matrix: 60 percent; decidedly less dense in appearance than underlying unit with ≈1 percent spherical opaques, 0.5 mm in diameter to limit of resolution; matrix becomes progressively more transparent upward.
Framework: 40 percent; rock fragments, similar in appearance to unit 34, ≈30 percent is semiopaque rock fragments with distinct outline; 10 percent is crenulate mottles with indistinct outline.

UNIT 34 Depth: TDS, 194.5 to 200 cm; lunar surface, 167.5 to 173 cm Thickness: 5.5 cm
Rock fragmental zone with relatively opaque matrix.
Matrix: 65 percent; relatively opaque to X-rays, compared to unit 35, but appears to be uniformly dense throughout with no distinct mottles or opaque fragments.
Framework: 35 percent; 25 percent is semiopaque rock fragments with distinct outline, 2 to 11 mm in diameter, poorly sorted, equant to slightly elongate, polygonal, relatively straight sided, subangular corners; 10 percent is semiopaque with indistinct outline, appears as indistinct mottles, 1 to 4 mm in diameter with finely crenulate fadeout.

UNIT 33 Depth: TDS, 200 to 202.5 cm; lunar surface, 173 to 175.5 cm Thickness: 2.5 cm
Moderately thin bed with abundant rock fragments.
Matrix: 80 percent; intermediate transparency with some granules as unit 32.
Coarse fraction: 20 percent; 10 percent is semiopaque rock fragments with distinct outline, 2 to 5 mm in diameter, moderately well sorted, elongate-equant polygonal with straight edges, subangular corners; 10 percent is semiopaque

ATTACHMENT IV-8

NASA-JSC